CLAIMS

What is claimed is:

1. An optical apparatus, comprising:
   a bottom surface and walls formed on a first substrate and substantially defining a detection volume and an upper opening thereof;
   an optical waveguide having an end face, the optical waveguide aligned substantially parallel to the first substrate and positioned so that at least a portion of light emerging from the end face enters the detection volume; and
   a photodetector having an active area on a detector substrate, the detector substrate mounted on the first substrate so as to cover at least a portion of the upper opening of the detection volume with at least a portion of the active area exposed to the detection volume.

2. The apparatus of Claim 1, wherein the walls are formed at least in part by a ridge protruding from the substrate.

3. The apparatus of Claim 1, wherein the walls are formed at least in part by a recessed area formed on the substrate.

4. The apparatus of Claim 1, wherein the optical waveguide is formed on the first substrate.

5. The apparatus of Claim 4, wherein the walls of the detection volume are formed at least in part from material used to form the cladding of the optical waveguide.

6. The apparatus of Claim 4, wherein the walls of the detection volume are formed at least in part by material used to form the core of the optical waveguide.

7. The apparatus of Claim 6, wherein the core material forming the core of the optical waveguide and partly forming the walls of the detection volume is non-contiguous.

8. The apparatus of Claim 1, wherein the optical waveguide is formed on a waveguide substrate, and the optical waveguide is mounted on the first substrate.

9. The apparatus of Claim 8, wherein light emerging from the end face of the optical waveguide may enter the detection volume through a passage through one of the walls thereof.

10. The apparatus of Claim 8, wherein light emerging from the end face of the optical waveguide may enter the detection volume through a substantially transparent segment of one of the walls thereof.

11. The apparatus of Claim 8, further comprising a reflective coating on an area of the first substrate where light emerging from the end face of the optical waveguide may enter the detection volume.

12. The apparatus of Claim 8, further comprising a reflective coating on the waveguide substrate at the end face of the optical waveguide.

13. The apparatus of Claim 1, further comprising substantially transparent embedding material substantially filling the detection volume, substantially covering the end face of the optical waveguide, and substantially filling an optical path between the end face of the optical waveguide and the detection volume.

14. The apparatus of Claim 13, wherein at least one wall of the detection volume has a passage therethrough for admitting liquid embedding material into the detection volume.

15. The apparatus of Claim 1, wherein the detection volume is substantially sealed by mounting of the photodetector over the upper opening of the detection volume.

16. The apparatus of Claim 15, further comprising a substantially flat substantially contiguous upper mounting surface surrounding the upper opening of the detection volume, wherein the upper mounting surface engages the photodetector to substantially seal the detection volume.

17. The apparatus of Claim 15, further comprising multiple substantially flat substantially coplanar upper mounting surfaces arranged around the upper

opening of the detection volume, wherein the upper mounting surfaces engage the photodetector and gaps between the upper mounting surfaces are substantially filled with at least one of adhesive and solder, thereby substantially sealing the detection volume.

18. The apparatus of Claim 1, further comprising a reflective coating on a least a portion of the bottom surface of the detection volume.

19. The apparatus of Claim 18, wherein the reflective coating comprises a metallic coating.

20. The apparatus of Claim 19, wherein the metallic reflective coating serves as an electrical contact for the photodetector.

21. The apparatus of Claim 1, wherein at least a portion of the inner face is tilted upward.

22. The apparatus of Claim 1, wherein at least a portion of the inner face is adapted for reducing optical feedback from the detection volume through the end face into the optical waveguide.

23. The apparatus of Claim 1, wherein the end face of the optical waveguide is tilted downward so that light emerging from the end face is refracted toward the photodetector.

24. A method, comprising:

forming a bottom surface and walls on a first substrate, thereby substantially defining a detection volume and an upper opening thereof;

positioning an optical waveguide substantially parallel to the first substrate so that at least a portion of light emerging from an end face of the optical waveguide enters the detection volume;

mounting a detector substrate on the first substrate so as to cover at least a portion of the upper opening of the detection volume with at least a portion of an active area on the detector substrate exposed to the detection volume.

25. The method of Claim 24, wherein the walls formed at least in part by a ridge protruding from the substrate.

26. The method of Claim 24, wherein the walls are formed at least in part by a recessed area formed on the substrate.

27. The method of Claim 24, further comprising forming the optical waveguide on the first substrate.

28. The method of Claim 27, wherein the walls of the detection volume are formed at least in part from material used to form the cladding of the optical waveguide.

29. The method of Claim 27, wherein the walls of the detection volume are formed at least in part by material used to form the core of the optical waveguide.

30. The method of Claim 29, wherein the core material forming the core of the optical waveguide and partly forming the walls of the detection volume is non-contiguous.

31. The method of Claim 27, further comprising:
forming bottom surfaces and walls on a common substrate wafer, thereby substantially defining multiple detection volumes concurrently;
forming multiple corresponding optical waveguides concurrently on the common substrate wafer; and
dividing the substrate wafer into individual substrates having thereon at least one detection volume and corresponding optical waveguide.

32. The method of Claim 24, further comprising:
forming the optical waveguide on a waveguide substrate; and
mounting the optical waveguide on the first substrate.

33. The method of Claim 32, further comprising forming a passage through one of the walls of the detection volume for admitting into the detection volume at least a portion of the light emerging from the end face of the optical waveguide.

34. The method of Claim 32, further comprising forming a substantially transparent segment of one of the walls of the detection volume for admitting into the detection volume at least a portion of the light emerging from the end face of the optical waveguide.

35. The method of Claim 32, further comprising forming a reflective coating on an area of the first substrate where light emerging from the end face of the optical waveguide may enter the detection volume.

36. The method of Claim 32, further comprising forming a reflective coating on the waveguide substrate at the end face of the optical waveguide.

37. The method of Claim 24, further comprising substantially covering the end face of the optical waveguide, substantially filling the detection volume, and substantially filling an optical path between the end face of the optical waveguide and the detection volume, with substantially transparent embedding material.

38. The method of Claim 37, further comprising forming a passage through at least one wall of the detection volume admitting liquid embedding material into the detection volume.

39. The method of Claim 24, wherein the detection volume is substantially sealed by mounting of the photodetector over the upper opening of the detection volume.

40. The method of Claim 39, further comprising forming a substantially flat substantially contiguous upper mounting surface surrounding the upper opening of the detection volume, wherein the upper mounting surface engages the photodetector to substantially seal the detection volume.

41. The method of Claim 39, further comprising forming multiple substantially flat substantially coplanar upper mounting surfaces arranged around the upper opening of the detection volume, wherein the upper mounting surfaces engage the photodetector and gaps between the upper mounting surfaces are substantially

filled with at least one of adhesive and solder, thereby substantially sealing the detection volume.

42. The method of Claim 24, further comprising forming a reflective coating on at least a portion of the bottom surface of the detection volume.

43. The method of Claim 42, wherein the reflective coating comprises a metallic coating.

44. The method of Claim 43, wherein the metallic reflective coating serves as an electrical contact for the photodetector.

45. The method of Claim 24, wherein at least a portion of the inner face is tilted upward.

46. The method of Claim 24, further comprising adapting at least a portion of the inner face is for reducing optical feedback from the detection volume through the end face into the optical waveguide.

47. The method of Claim 24, wherein the end face of the optical waveguide is tilted downward so that light emerging from the end face is refracted toward the photodetector.

48. An optical apparatus, comprising:

a bottom surface and walls formed on a first substrate and substantially defining a detection volume and an upper opening thereof;

a semiconductor laser having a first laser end face and a second laser end face, the semiconductor laser aligned substantially parallel to the first substrate and positioned so that at least a portion of light emerging from the first laser end face enters the detection volume; and

a photodetector having an active area on a detector substrate, the detector substrate mounted on the first substrate so as to cover at least a portion of the upper opening of the detection volume with at least a portion of the active area exposed to the detection volume.

49. The apparatus of Claim 48, further comprising an optical waveguide positioned so that at least a portion of light emerging from the second laser end face enters the optical waveguide.

50. The apparatus of Claim 49, wherein the optical waveguide comprises a planar optical waveguide formed on the first substrate.

51. The apparatus of Claim 49, wherein the optical waveguide is mounted on the first substrate.

52. The apparatus of Claim 49, wherein at least a portion of the light emerging from the second laser end face enters the optical waveguide through an end face thereof.

53. The apparatus of Claim 49, wherein at least a portion of the light emerging from the second laser end face enters the optical waveguide by transverse-coupling thereto.

54. The apparatus of Claim 48, wherein the semiconductor laser is formed on the first substrate.

55. The apparatus of Claim 48, wherein the semiconductor laser is formed on a laser substrate and mounted on the first substrate.